Chapter 8

System Accessories

CHAPTER 8 PIPELINE SYSTEM ACCESSORIES

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PIPELINE SYSTEM ACCESSORIES

8.1 SPRING FED PIPELINE ENTRANCE

There are many ways that water can be collected at a spring and led into a pipeline. Figures 8.1 through 8.4 illustrate some typical installations. Other spring development plans are shown in Misssouri Standard Drawings and Specifications Handbook.

If the spring yields any kind of sediment along with the water, a spring box should be installed. A spring box is also useful for monitoring and maintaining the spring water collection system.

Chapter 12 of the Natural Resources Conservation Service Engineering Field Handbook provides information on developing springs and spring water collection systems.

Figure 8.1
TYPICAL SPRING BOX AND PIPE COLLECTION

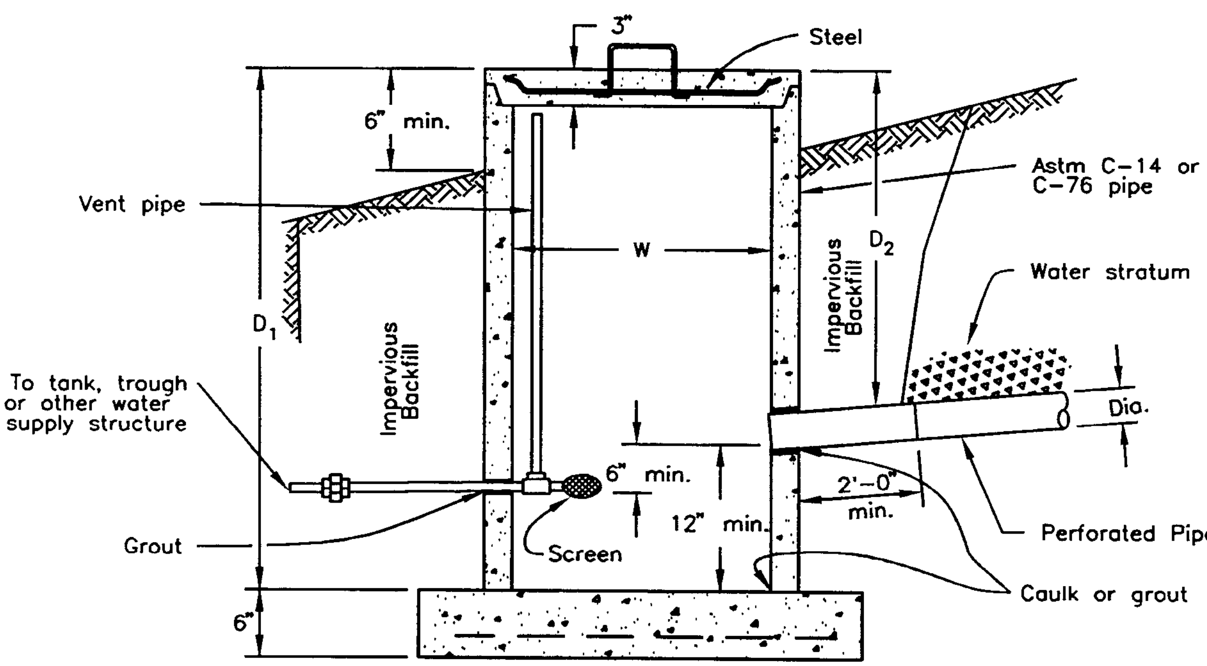


Figure 8.2
TYPICAL SPRING BOX DIRECT COLLECTION

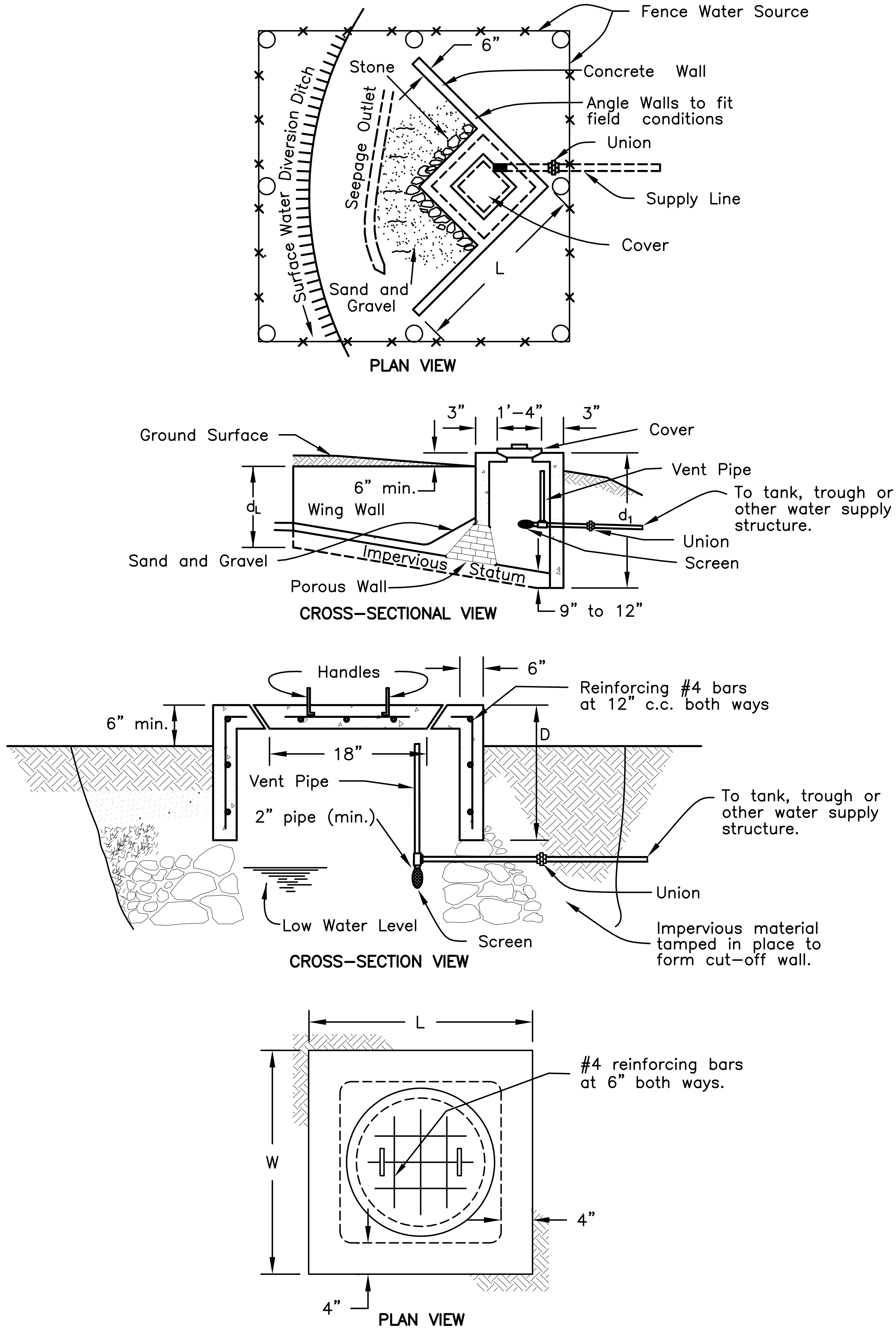
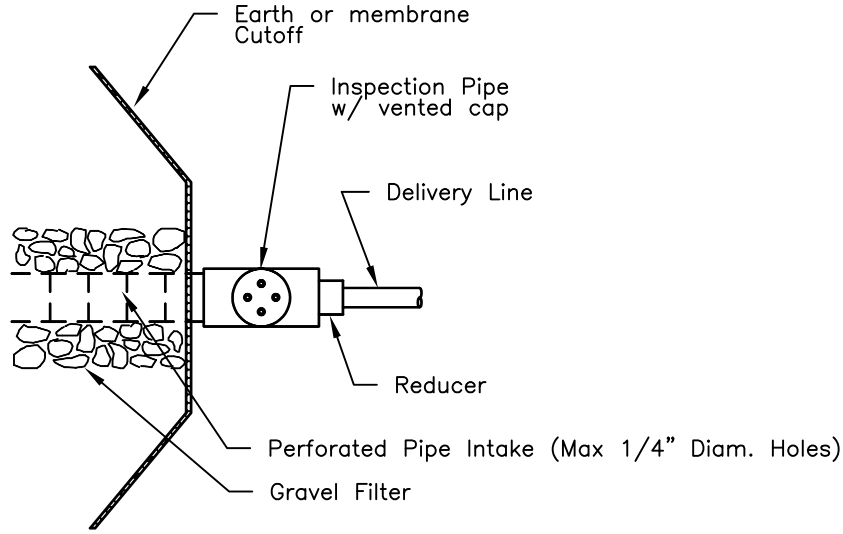
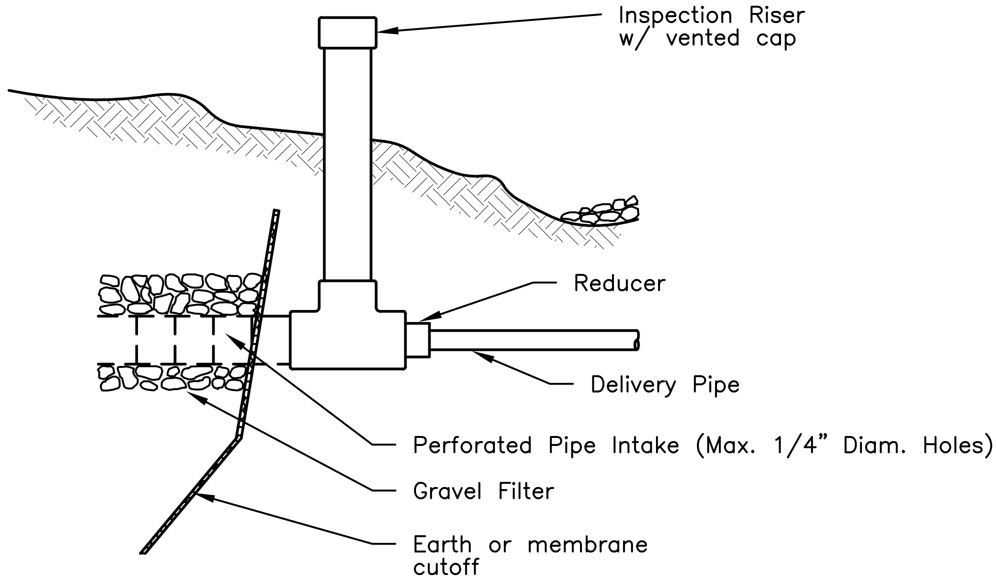


Figure 8.3
WATER COLLECTION WITHOUT SPRING BOX



PLAN

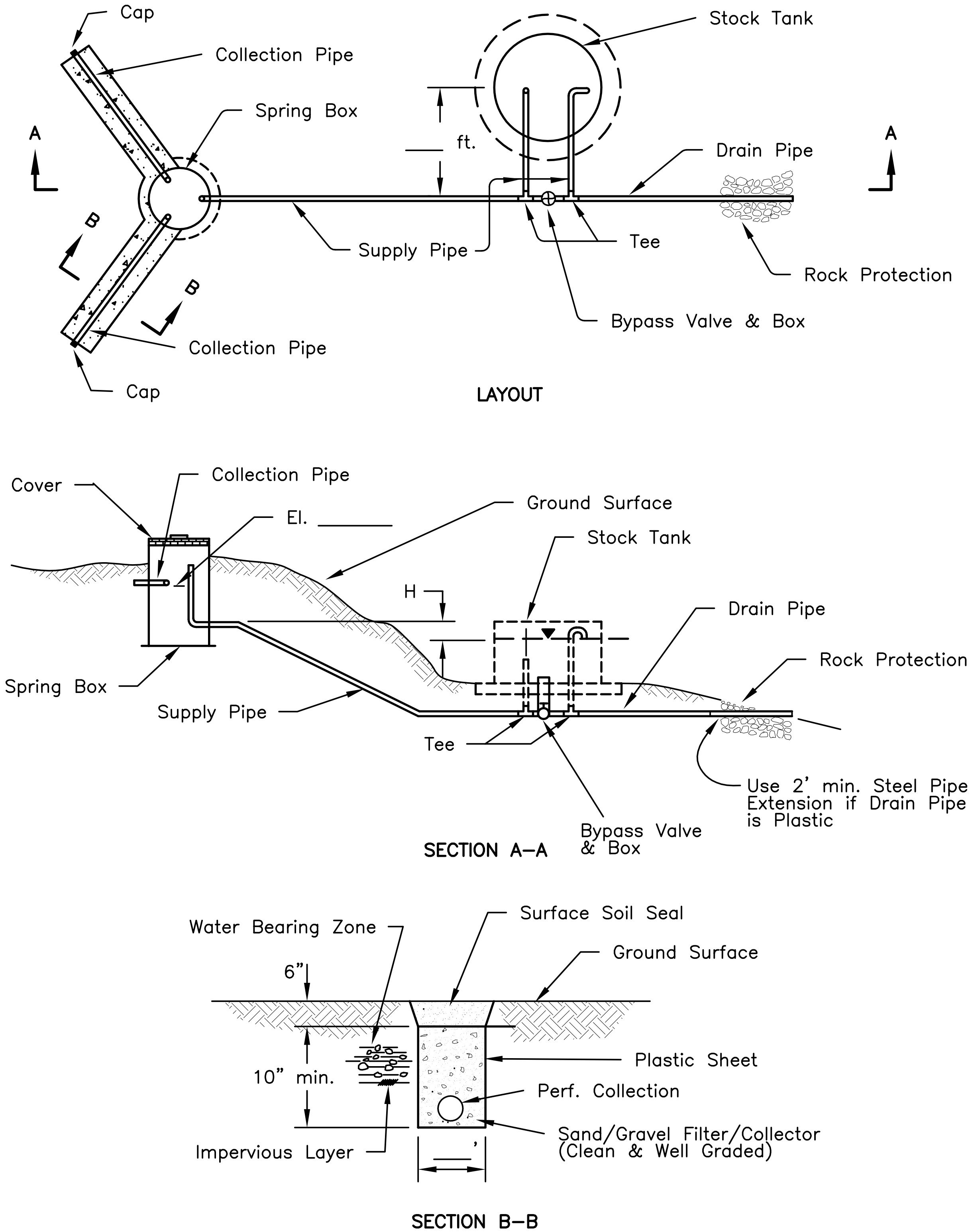


PROFILE

Note:

1. Instead of a "T", a "Y" may be installed with the riser at a 45 degree angle with the ground. This will allow using a snake to clean out the perforated drain pipe.
2. Drilling 24–1/4" diameter holes per foot will make a good perforated pipe intake for 4 inch diameter PVC pipe.

Figure 8.4
TYPICAL SPRING FED PIPELINE



8.2 WELLS AND SUMPS

Figure 8.6 illustrates a typical pitless adapter type of submersible pump installation. The pitless adapter puts the top of the well casing above the surrounding ground so contaminating water will not run into the well. The pipe exits the well casing below the frost line.

In the past, many wells were constructed so the top ended up below ground in the bottom of a pit. If the pit were flooded, the well, and possibly the groundwater aquifer, could become contaminated. This type of installation is no longer acceptable.

State health laws regulate how wells are constructed so the potential for water contamination is minimized. It is important to become familiar with these regulations when planning stockwater systems involving wells.

Chapter 12 of the Natural Resources Conservation Service Engineering Field Handbook (EFH) provides more information on wells.

8.3 PUMPS

There are many kinds of pumps used in stockwater pipelines. The kind which will work best depends on available sources of power, flow rate, head requirements, and water source.

Availability of electric power is frequently a major factor in determining whether or not an electric pump can be used. If power is not already available at the water source, it can be very expensive to bring in power. When planning a stockwater system requiring pumping, electric power availability and cost of bringing in electric power are two of the first things that must be considered.

8.3.1 Submersible Electric Pump, Jet, Turbine and Piston Pumps.

FOR DETAILS SEE SHEETS 25 TO 38 OF MIDWEST PLAN SERVICE PUBLICATION MWPS-14.

8.3.2 Windmill

Windmills can still be used to great advantage when power is not available at a site. The most important factor is to provide adequate water storage to carry over during periods of little or no wind. Windmills also require frequent checking and maintenance.

Figure 8.5
WINDMILL AS SUPPLY TO TANK

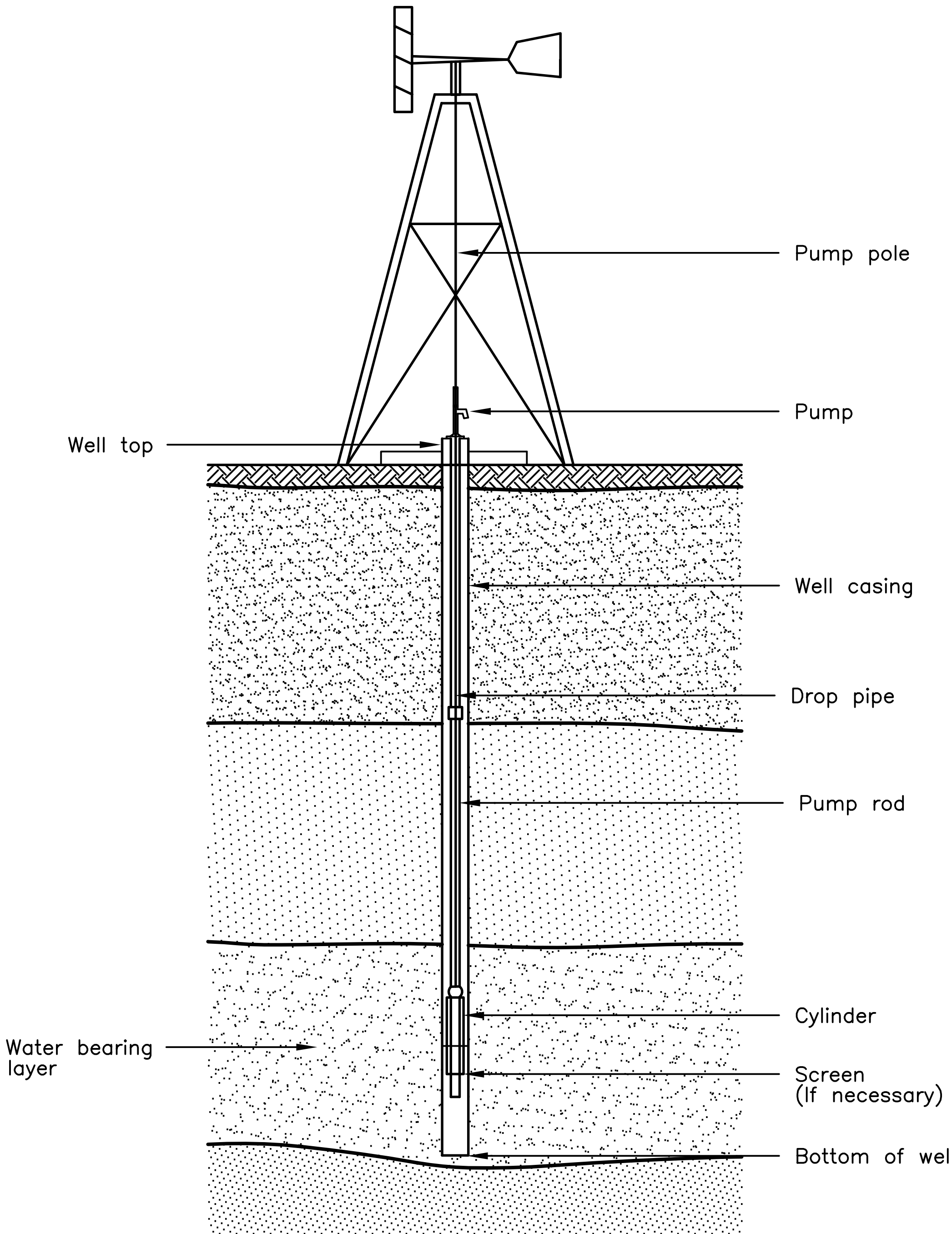


Figure 8.6 illustrates how to connect a windmill to a pipeline. When designing a windmill supplied pipeline the total dynamic head equals static head plus losses in the drop pipe plus pipeline losses.

Figure 8.6
WINDMILL CONNECTED TO PIPELINE

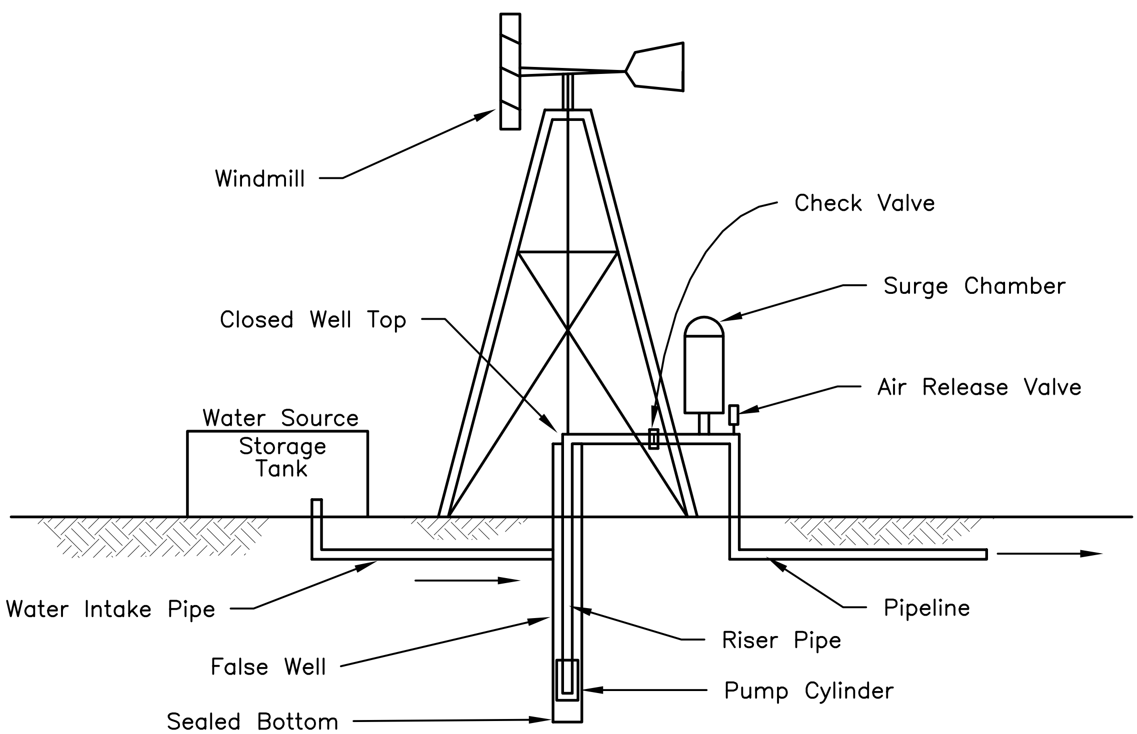


Table 8.1 tabulates approximate windmill capacities and Table 8.2 tabulates approximate pumping heads. These are based on winds exceeding 12 mph. Short stroke systems increase pumping head by 1/3 and reduce pumping capacity by 1/4.

For 12 mph winds, capacity is reduced about 20% and for 10 mph winds, about 38%. If prevailing winds are low, use of a cylinder smaller than shown will permit the mill to operate in lower wind velocity.

The drop pipe should never be smaller than the pump cylinder. For deep wells, use a ball valve and lightweight rod.

Table 8.1
APPROXIMATE WINDMILL CAPACITY
(Gallons per hour)

Cylinder Diameter (inches)	Wheel Diameter (feet)	
	6 feet	8-16 feet
1-3/4	105	150
1-7/8	125	180
2	130	190
2-1/4	180	260
2-1/2	225	325
2-3/4	265	385
3	320	470
3-1/4	370	550
3-1/2	440	640
3-3/4	500	730
4	570	830
4-1/4	---	940
4-1/2	725	1050
4-3/4	---	1170
5	900	1300
5-3/4	---	1700
6	---	1875
7	---	2550
8	---	3300

Table 8.2
WINDMILL PUMPING HEAD
(feet)

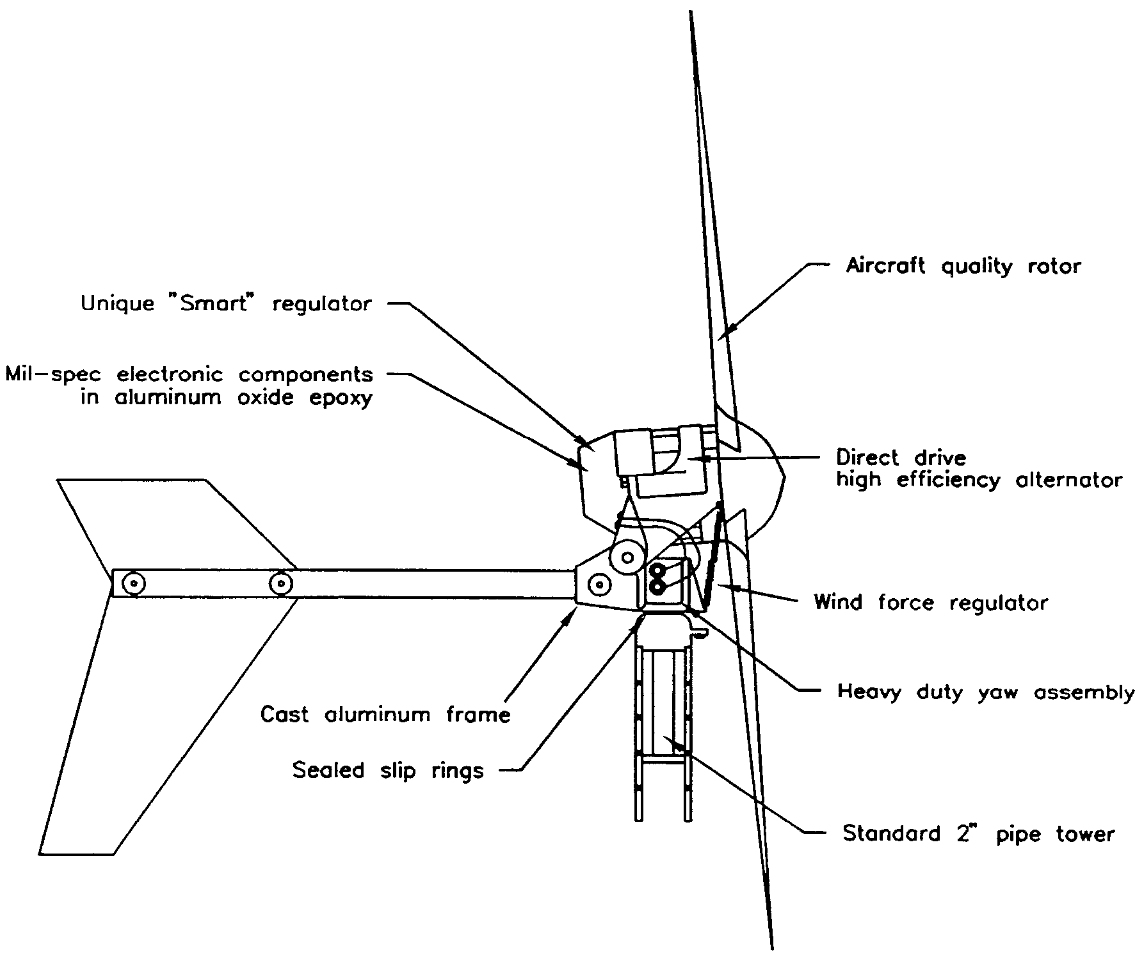
Cylinder Diameter (inches)	Wheel Diameter (feet)					
	6	8	10	12	14	16
3/4	130	185	280	420	600	1000
1-7/8	120	175	260	390	560	920
2	95	140	215	320	460	750
2-1/4	77	112	170	250	360	590
2-1/2	65	94	140	210	300	490
2-3/4	56	80	120	180	260	425
3	47	68	100	155	220	360
3-1/4	41	58	88	130	185	305
3-1/2	35	50	76	115	160	265
3-3/4	30	44	65	98	143	230
4	27	39	58	86	125	200
4-1/4	-	34	51	76	110	180
4-1/2	21	30	46	68	98	160
4-3/4	-	-	41	61	88	140
5	7	25	37	55	80	130
5-3/4	-	-	-	40	60	100
6	-	17	25	38	55	85
7	-	-	19	28	41	65
8	-	-	14	22	31	50

8.3.3 Wind Generator Powered Pump

Wind generators can be used to power low volume pumps. These systems are expensive and have the same disadvantage as windmills in that they depend on wind being available to pump water. They may be more reliable than windmills because there are less mechanical components to go wrong. It may also be possible to pump water from deeper depths.

Figure 8.7 illustrates a wind generator. This small generator delivers 12 or 24 volt power and might be used with the same type of pumps as solar powerd pumps, or might be used in conjunction with solar power.

Figure 8.7
WIND GENERATOR POWERED PUMP



8.3.4 Solar Powered Pump System

Solar powered pumps have the advantage of operating as long as there is adequate sunlight. In many parts of Missouri this is a particular advantage because we have a high percentage of non-overcast days.

The main disadvantage of this type of installation is that it is expensive. This can be more than compensated for though by not having to install power lines to the site.

As with wind powered systems, it is important to have adequate tank storage to carry through periods of low sunlight levels and heavy water use.

Figures 8.8 illustrates low voltage DC solar powered pump systems using a submersible pump in a well and a rotary vane type pump from a spring box. A tracking type solar pannel allows greater power gain throughout the day. These are simple systems without batteries or converters.

Figure 8.9 illustrates a pump jack system. This works in deeper wells and is ideal for replacing windmill systems. The pump will pump water even under low light conditions, although pumping will be slower.

There are several different types of pump systems on the market. Each has particular advantages . Design must be done in close coordination with pump and solar panel suppliers.

Figure 8.8
TYPICAL SOLAR SUBMERSIBLE AND ROTARY VANE TYPE PUMPS

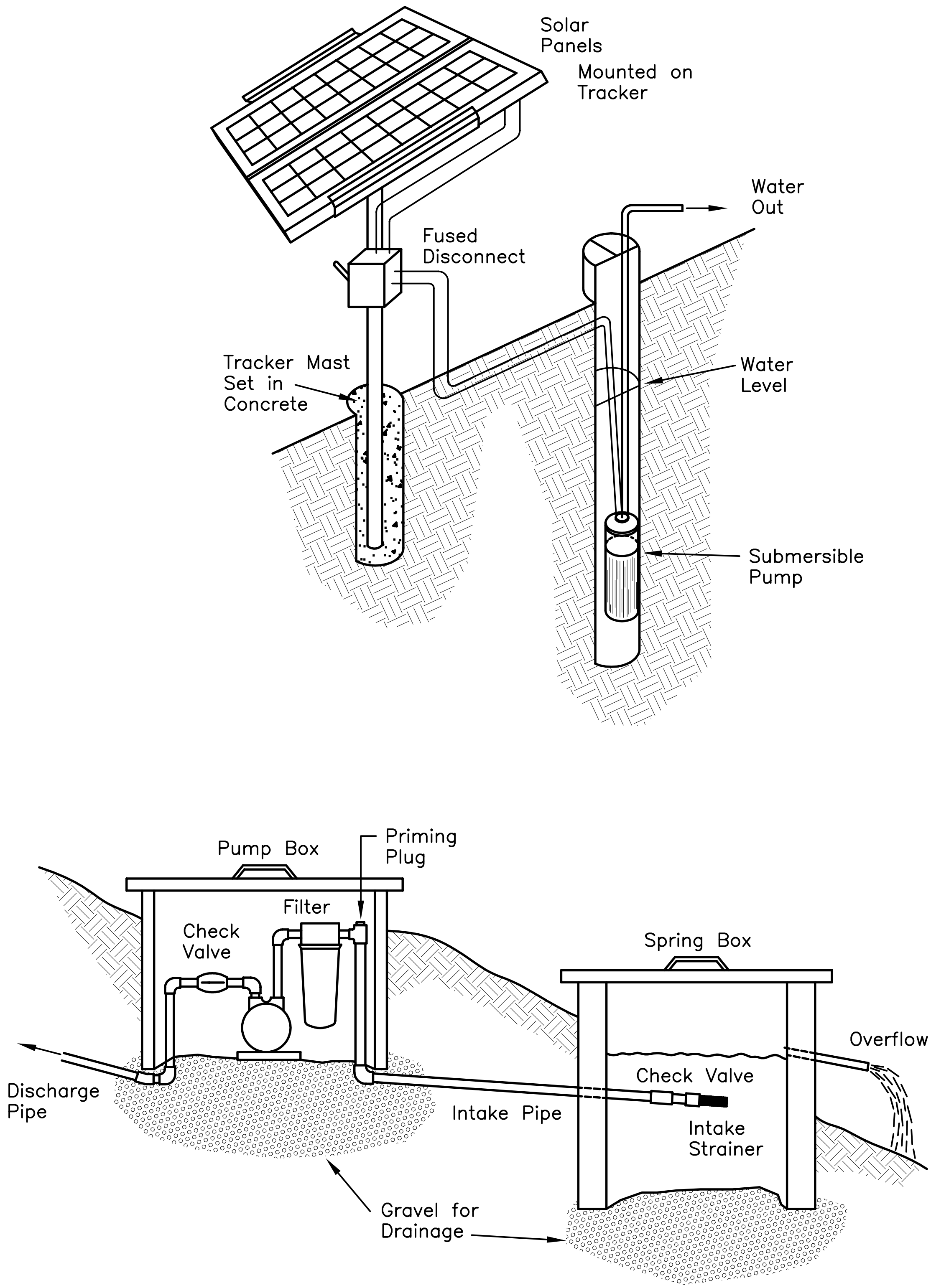
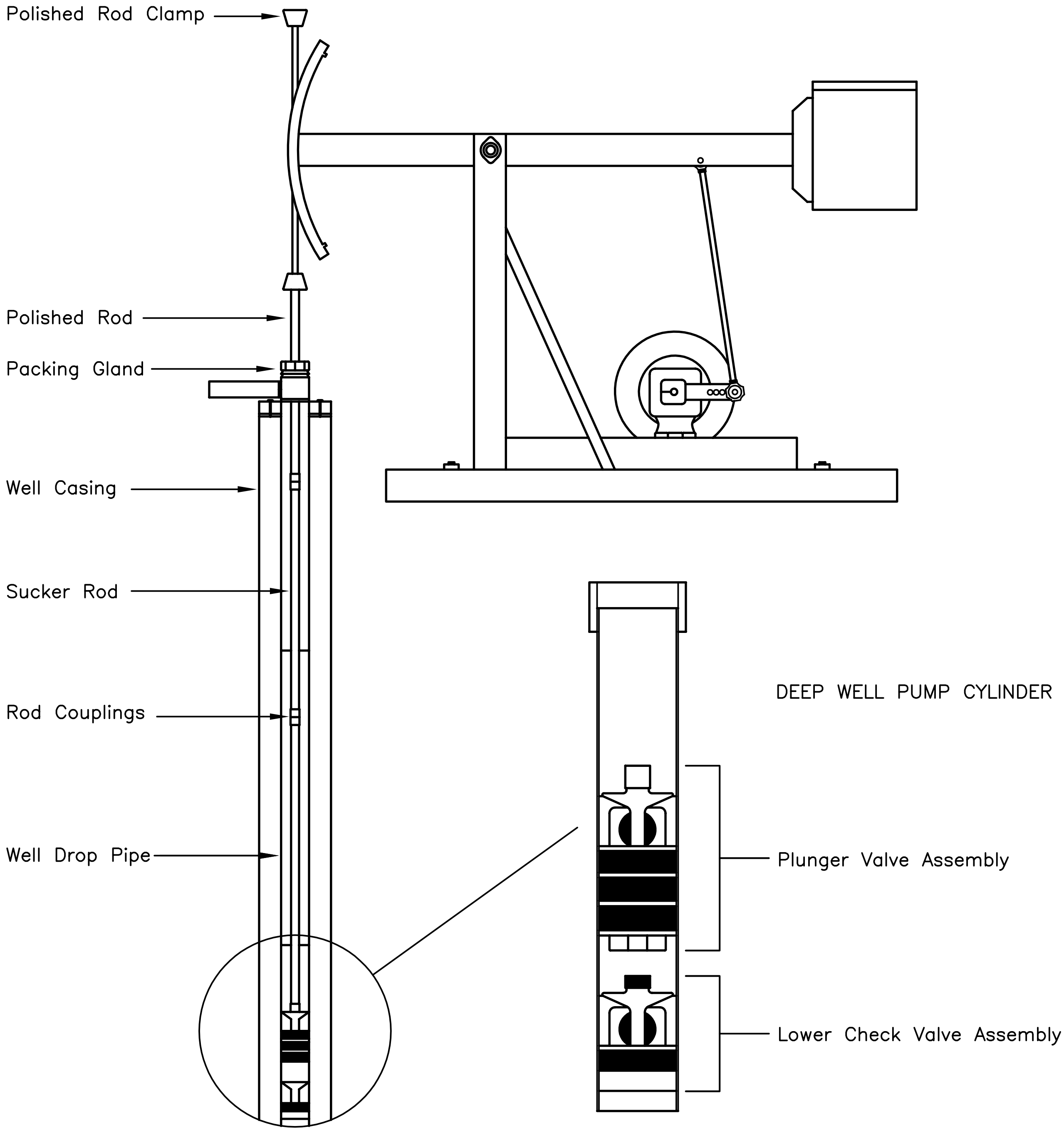


Figure 8.9
JACK TYPE SOLAR PUMP



8.3.5 Internal Combustion Engine Powered Pumps

Internal combustion engines can be used to operate stockwater pumps. The engines are sometimes started with float operated automatic starter and shutoff switches. These engines frequently use propane as a fuel.

Engine operated systems require frequent monitoring. A large water storage tank should be part of the system to supplement times when the system fails or for some other reason is not started on time.

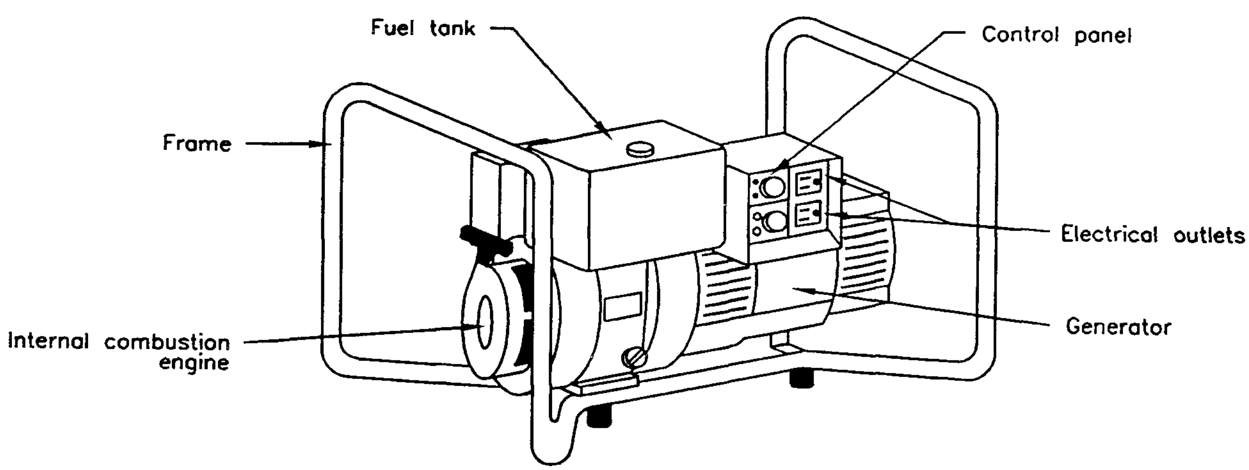
There are various ways that such a system can be set up. They include:

1. An engine operated pump jack is operated by gas or propane motor. Water is pumped into a large storage tank. The engine is started by hand. It can be shut off with simple grounding type float switch or when it simply runs out of gas. Sometimes an automatic starting system is used.

2. An engine operated generator which in turn operates any type of electrically driven pump system. This type of system can either be automatically started and stopped with a float switch or manually started and then shut off by a float actuated switch in the storage tank. Figure 8.10 illustrates what a typical generating system may look like.

   This system has the advantage of being able to operate any size or pressure rated pump, depending on the size of the generating system. It is one of the most popular types of non-commercial power systems used.

Figure 8.10
PORTABLE GENERATOR FOR PUMP



8.3.6 Hydraulic Rams

A hydraulic ram works on the principal of using large volume flow at low head to pump smaller volumes of flow to a higher elevation.

Figure 8.11 illustrates how this type of system is set up. A poppet valve in the ram opens allowing water to flow. As the water gains velocity in the supply pipe, it causes the popet to slam shut. This sudden closure causes a surge pressure which forces the water through the pump check valve. The surge pressure runs into the back pressure in the output line. Part of the water flow is forced into the air chamber, compressing the air and causing the flow to lose most of its energy.

As peak pressure subsides, the compressed air in the air chamber pushes downward on the column of water, closes the check valve and pushes some water up the delivery pipe. This process repeats itself about once a second.

A shock wave (water hammer) moves back up the supply pipe. The pipe pressure rating should be adequate to withstand this repeated shock. A stand pipe is frequently installed at a location in the supply line that "tunes" the system shock wave. This stand pipe should be about 4 to 5 times the supply pipe fall away from the ram.

Ram manufacturer recommendations should be used to size the ram and design the system.

Figure 8.11
TYPICAL HYDRAULIC RAM INSTALLATION

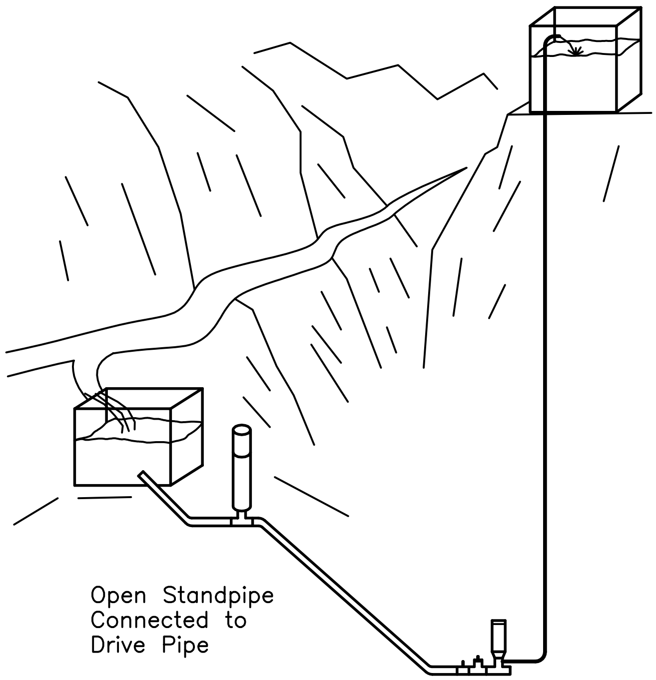


Figure 8.12
SMALL PLASTIC HYDRAULIC RAM

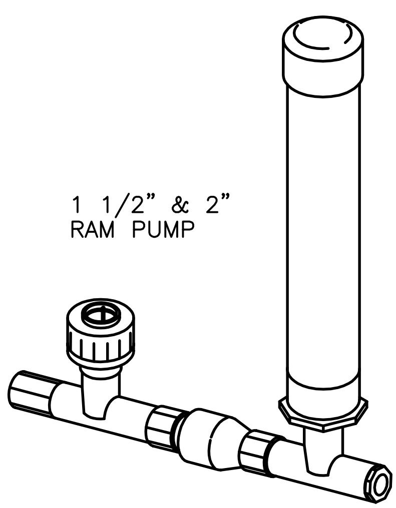
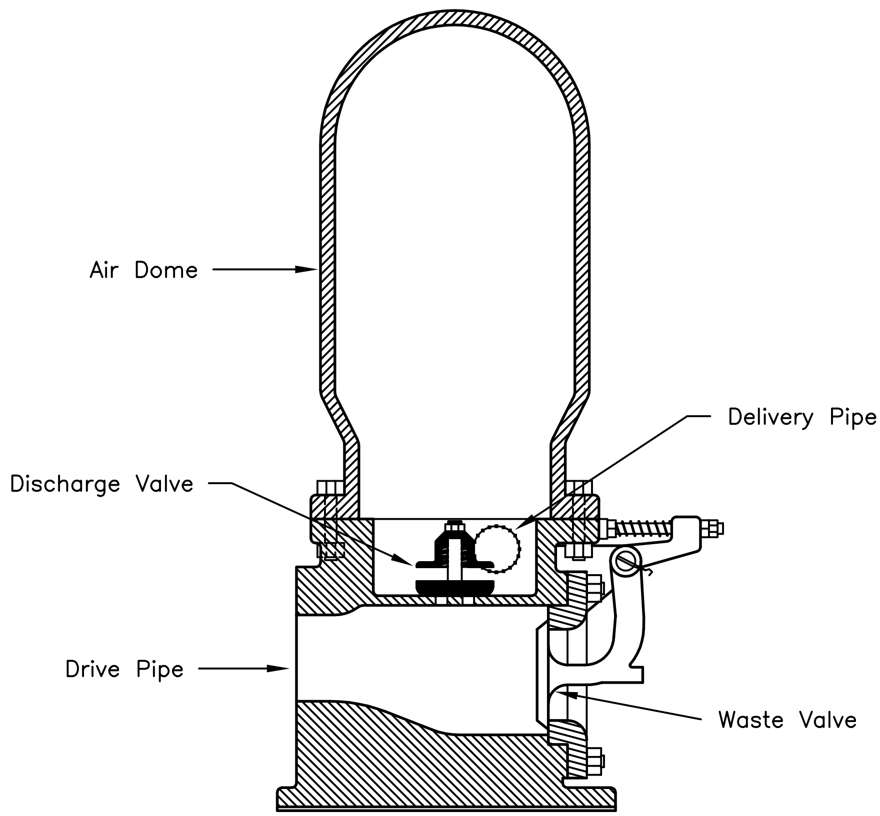
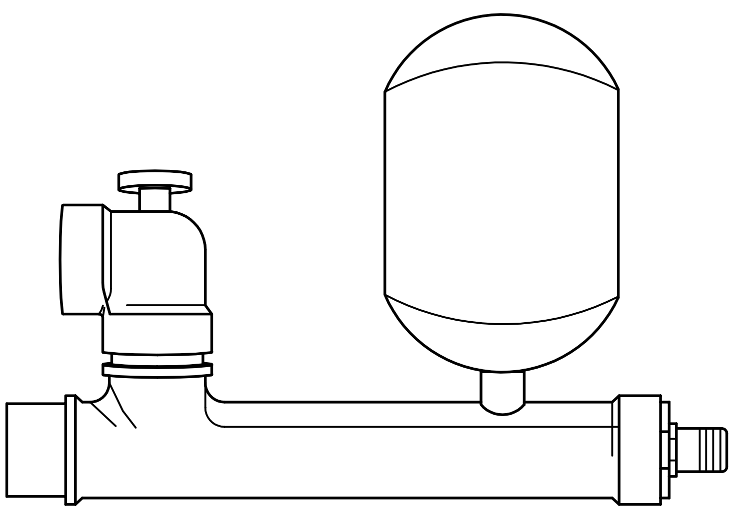


Figure 8.13
LARGE STEEL HYDRAULIC RAMS





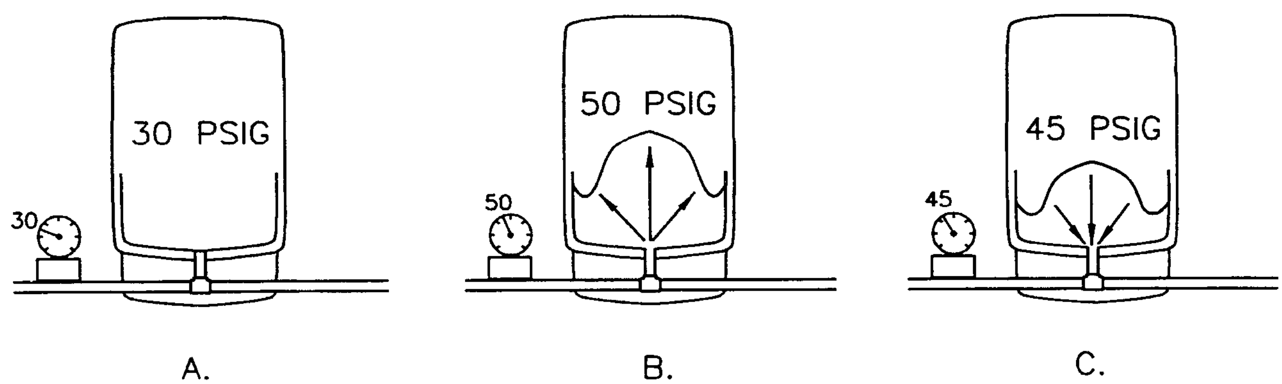
8.4 PRESSURE TANKS

Pneumatic pressure tank operation is based on the fact that air can be compressed but water cannot. The pressure required to force water from the tank through the pipeline to stock tanks is obtained by incorporating air in the tank and by the pump forcing water against the air pocket. The air is forced to occupy less and less space and so exerts more and more pressure on incoming water.

This air cushion acts like a large spring maintaining a constant pressure on the water in the tank which is conducted throughout the entire system. When a hydrant or float valve is opened, air expands to replace the water which is forced through the pipes by air pressure. When the pump starts and forces additional water into the tank, air is compressed at a higher pressure and occupies less space.

There are two types of pressure tanks, the plain tank and the diaphragm-type tank. Operation of both tanks is the same. The difference is that water and air are separated by a diaphragm in a diaphragm-type tank. The diaphragm prevents loss of air during operation. Figure 8.14 illustrates how a pressure tank works. Net effective storage of the tank is equal to the water volume that is stored between cut-in pressure and cut-out pressure.

Figure 8.14
HOW A PRESSURE TANK WORKS

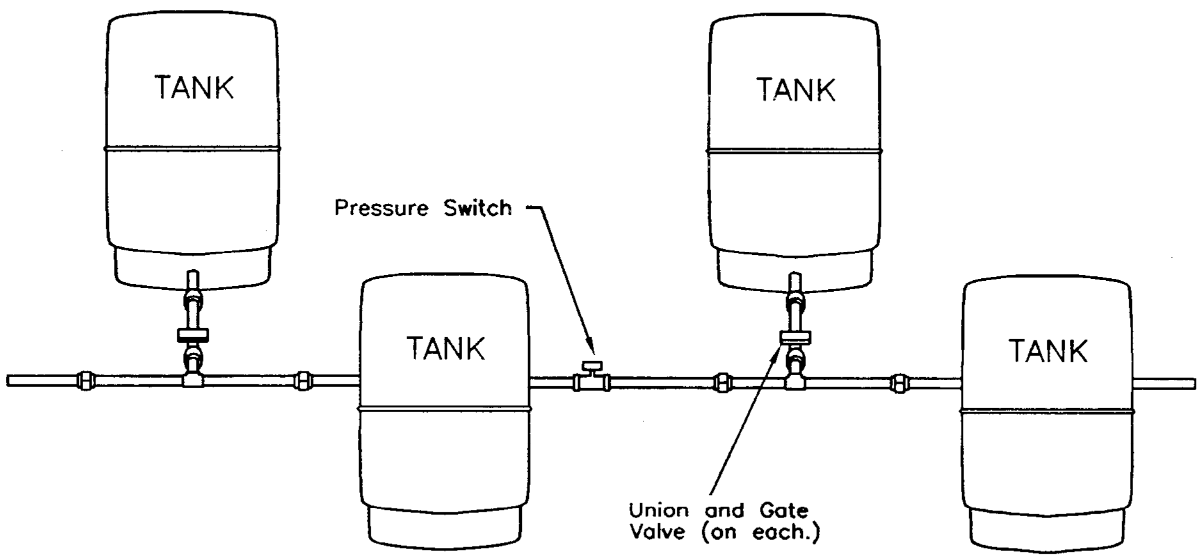


Cut-in pressure is that pressure at which the pump is automatically turned on. Cut-out is the pressure at which the pump is turned off.

Tanks operating with a cut-out pressure of less than 80 psi usually have a 20 psi pressure spread between cut-in and cut-out. Tanks operating at pressures higher than that usually operate with a pressure spread of 30 psi. At pressures above 120 psi it sometimes may be advantageous to operate with a pressure spread greater than 30 psi. See Tables 8.3 through 8.12 for tank sizes based on flow rate and pressure spread between cut-in and cut-out.

More than one tank may be installed in a system to meet pressure tank capacity requirements. Figure 8.15 illustrates how this is done.

Figure 8.15
MULTIPLE PRESSURE TANK INSTALLATION



8.4.1 Plain Pressure Tank

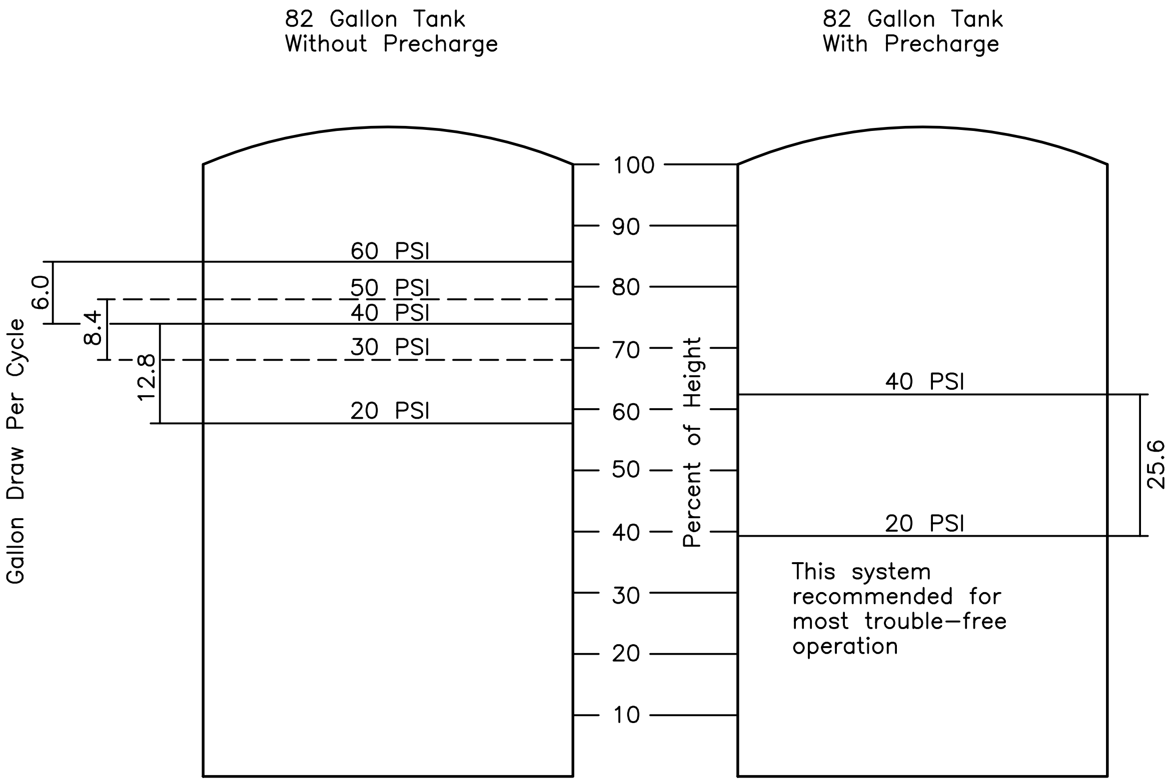
In a plain pressure tank, air can be lost over time. This loss is due to absorption into the water or, if pressure in the system falls below a certain point, air can escape into the pipeline.

Figure 8.16 illustrates the water level in a standard vertical tank at various pressures, percent of height, and gallons of drawdown per cycle. To determine the drawdown per cycle at a given pressure switch setting, refer to the left side of Figure 8.16. With a pressure setting of 20/40 psi and using an 82 gallon tank without pre-charge the amount of water available is 12.8 gallons. If the tank is pre-charged, as shown in the right side of Figure 8.16, the amount of available water will be 25.6 gallons.

There is a valve on the plain tank where compressed air can periodically be used to recharge the air space. This is usually done with a hand pump or portable compressor. In some systems, this must be done several times during a season. In larger installations, an automatic air compressor can be used to keep the tank properly charged.

There is a simple automatic charging valve available which can be used to automatically recharge the air tank. This valve only works in a jet-type pump installation. It will not work with a submersible pump. This valve can only be used on low-to-moderate pressure systems.

Figure 8.16
PLAIN PRESSURE TANK CAPACITY



8.4.2 Diaphragm-Type Tank

A diaphragm tank abolishes the need for tank air maintenance. In fact, properly protected diaphragm tanks can be buried after they are initially charged with air.

In the diaphragm-type tank, a flexible diaphragm separates air and water. An example of this type of tank is shown in Figure 8.14. Air cannot be absorbed by water and air can-not escape. After an initial charge of compressed air, periodic recharging is not required. This type of tank is almost universally used on new systems today and its use is highly recommended.

8.4.3 Tank Pressure Rating

Common pressure tanks are rated for maximum pressures between 72 psi and 110 psi. For this reason, there are increasing problems with using an automatic pressure system when operating pressures exceed 110 psi. Larger and higher pressure rated tanks are required at these higher pressures.

For practical reasons, the design upper limit for cut-out pressure is about 150 psi. For systems with pressures above this, timer operated, manually operated, or float switch operated systems should be used.

It is very dangerous to use a tank at higher than its rated pressure. A tank used beyond it's rating could explode and cause death or serious injury to anyone working near the tank. For that reason **a pressure tank should never be used beyond its rated pressure**.

Sometimes owners want to use "used" tanks such as old propane tanks as water pressure tanks. These tanks are not designed for water use since they will soon corrode and weaken. **Pressure tanks not manufactured for water containment should not be used.**

Special pressure tanks are available with ratings beyond 110 psi. These are expensive and must be properly sized.

In any automatic high pressure system, additional efficient storage can be added by installing multiple diaphragm-type pressure tanks out on the pipeline where pressures are relatively low. These tanks are usually the buried-type. In such a system, it is desirable to have a primary high pressure tank located at the well. This tank takes the initial surge of flow and allows flow and pressures to equalize in the pipeline

It also may be effective to install a flow regulating valve just up stream of the pressure switch to control initial flow rate. Without control of surge flow at the pump, frequent pump cycling can occur due to pressure surges actuating the pressure switch. This can quickly destroy the pump and/or pipeline.

8.4.4 **FOR ADDITIONAL DETAILS OF PRESSURE TANKS AND CONTROLS SEE MIDWEST PLAN SERVICE PUBLICATION MWPS-14, PAGES 39 THRU 40.**

Table 8.3
DIAPHRAGM PRESSURE TANK SIZE SELECTION
MINIMUM RECOMMENDED TOTAL STORAGE TANK SIZE (gallons)

Flow = 5 gpm, Minimum Pump Running Time = 1.5 minutes

Pump CUT-OUT Pressure (PSIG)	Pump CUT-IN Pressure (PSIG) 20	30	40	50	60	70	80	90	100	110	120	130	140
30	33												
40	20	41											
50	16	24	48										
60	14	19	28	56									
70	13	16	21	32	64								
80	12	14	18	24	36	71							
90	11	13	16	20	26	39	78						
100	11	12	14	17	22	29	43	86					
110	10	12	13	16	19	23	31	47	94				
120	10	11	13	14	17	20	25	34	50	107			
130	10	11	12	14	15	18	22	27	36	54	109		
140	10	11	12	13	15	17	19	23	29	39	58	117	
150	10	10	11	12	14	15	18	21	25	31	41	62	125

The minimum storage tank size in tables 8.3 through 8.12 are intended as a guide. Other sizes as recommended by pump manufacturers and pump installers may be used.

Table 8.4

DIAPHRAGM PRESSURE TANK SIZE SELECTION

MINIMUM RECOMMENDED TOTAL STORAGE TANK SIZE (gallons)

Flow = 10 gpm, Minimum Pump Running Time = 1.5 minutes

Pump CUT-OUT Pressure (PSIG)	Pump CUT-IN Pressure (PSIG) 20	30	40	50	60	70	80	90	100	110	120	130	140
30	67												
40	41	82											
50	32	49	97										
60	28	37	56	112									
70	25	32	42	64	127								
80	24	28	36	47	71	142							
90	22	26	31	39	52	79	156						
100	21	25	29	34	43	57	86	172					
110	21	23	27	31	37	47	62	94	188				
120	20	22	25	29	34	40	51	67	101	214			
130	20	22	24	27	31	36	43	54	72	109	217		
140	19	21	23	26	29	33	39	46	58	77	116	234	
150	19	21	22	25	27	31	35	41	49	62	82	124	250

Table 8.5
DIAPHRAGM PRESSURE TANK SIZE SELECTION
MINIMUM RECOMMENDED TOTAL STORAGE TANK SIZE (gallons)

Flow = 15 gpm, Minimum Pump Running Time = 1.5 minutes

Pump CUT-OUT Pressure (PSIG)	Pump CUT-IN Pressure (PSIG)												
	20	30	40	50	60	70	80	90	100	110	120	130	140
30	100												
40	61	123											
50	48	73	145										
60	42	56	84	168									
70	38	48	64	95	191								
80	35	43	53	71	107	212							
90	34	39	47	59	78	118	234						
100	32	37	43	52	65	86	129	259					
110	31	35	40	47	56	70	93	141	281				
120	30	34	38	43	50	61	76	101	151	321			
130	30	33	36	41	46	54	65	81	108	163	326		
140	29	32	35	39	44	50	58	69	87	116	174	352	
150	29	31	34	37	41	46	53	62	74	93	124	186	375

Table 8.6
DIAPHRAGM PRESSURE TANK SIZE SELECTION
MINIMUM RECOMMENDED TOTAL STORAGE TANK SIZE (gallons)

Flow = 20 gpm, Minimum Pump Running Time = 1.5 minutes

Pump CUT-OUT Pressure (PSIG)	Pump CUT-IN Pressure (PSIG)												
	20	30	40	50	60	70	80	90	100	110	120	130	140
30	134												
40	82	164											
50	65	97	194										
60	56	75	112	224									
70	51	64	85	127	254								
80	47	57	71	95	142	283							
90	45	52	63	79	105	157	313						
100	43	49	57	69	86	115	172	345					
110	41	47	53	62	75	93	124	188	375				
120	40	45	51	58	67	81	101	135	201	429			
130	39	43	48	54	62	72	87	108	144	217	435		
140	39	42	46	52	58	66	77	93	116	155	233	469	
150	38	41	45	49	55	62	70	82	98	123	165	248	500

Table 8.7
DIAPHRAGM PRESSURE TANK SIZE SELECTION
MINIMUM RECOMMENDED TOTAL STORAGE TANK SIZE (gallons)

Flow = 25 gpm, Minimum Pump Running Time = 1.5 minutes

Pump CUT-OUT Pressure (PSIG)	Pump CUT-IN Pressure (PSIG)												
	20	30	40	50	60	70	80	90	100	110	120	130	140
30	167												
40	102	205											
50	81	121	242										
60	70	93	140	280									
70	64	79	106	159	318								
80	59	71	89	118	178	354							
90	56	65	78	98	131	196	391						
100	54	61	72	86	108	144	216	431					
110	52	58	67	78	94	117	156	234	469				
120	51	56	63	72	84	101	126	168	252	536			
130	49	54	60	68	77	90	108	135	180	272	543		
140	48	53	58	64	73	83	97	116	145	193	291	586	
150	48	51	56	62	69	77	88	103	123	154	206	310	625

Table 8.8
PLAIN PRESSURE TANK SIZE SELECTION
MINIMUM RECOMMENDED TOTAL STORAGE TANK SIZE (gallons)
(Based on 3,000 ft. elevation above sea level)
WITHOUT AIR VALVE

Flow = 5 gpm, Minimum Pump Running Time = 1.5 minutes

Pump CUT-OUT Pressure (PSIG)	Pump CUT-IN Pressure (PSIG) 20	30	40	50	60	70	80	90	100
30	136								
40	83	216							
50	66	127	308						
60	57	97	177	417					
70	51	82	133	235	539				
80	48	74	113	177	308	719			
90	45	68	100	147	227	392	862		
100	43	64	90	128	185	281	462	995	
110	42	61	85	117	162	231	340	562	1294
120	40	58	78	105	141	190	259	370	588
130	39	56	75	99	129	170	223	301	431
140	39	54	73	95	123	160	205	270	370

NOTES:

(1) If an automatic air charge valve is used, tank size may be reduced by 50%.

(2) Increase tank size by 5% for each 1,000 feet elevation above 3,000 feet elevation.

Table 8.9
PLAIN PRESSURE TANK SIZE SELECTION
MINIMUM RECOMMENDED TOTAL STORAGE TANK SIZE (gallons)
(Based on 3,000 ft. elevation above sea level)
WITHOUT AIR VALVE

Flow = 10 gpm, Minimum Pump Running Time = 1.5 minutes

Pump CUT-OUT Pressure (PSIG)	Pump CUT-IN Pressure (PSIG) 20	30	40	50	60	70	80	90	100
30	272								
40	167	431							
50	131	254	616						
60	113	195	354	835					
70	103	165	267	470	1078				
80	96	148	225	354	616	1437			
90	91	136	199	294	454	784	1725		
100	87	127	181	256	370	562	924	1990	
110	84	121	169	233	323	462	681	1125	2587
120	81	115	157	210	281	381	517	739	1176
130	79	111	150	198	259	340	446	602	862
140	78	109	145	190	246	319	411	539	739

NOTES:

(1) If an automatic air charge valve is used, tank size may be reduced by 50%.

(2) Increase tank size by 5% for each 1,000 feet elevation above 3,000 feet elevation.

Table 8.10
PLAIN PRESSURE TANK SIZE SELECTION
MINIMUM RECOMMENDED TOTAL STORAGE TANK SIZE (gallons)
(Based on 3,000 ft. elevation above sea level)
WITHOUT AIR VALVE

Flow = 15 gpm, Minimum Pump Running Time = 1.5 minutes

Pump CUT-OUT Pressure (PSIG)	Pump CUT-IN Pressure (PSIG)								
	20	30	40	50	60	70	80	90	100
30	409								
40	250	647							
50	197	381	924						
60	170	292	532	1252					
70	154	247	400	706	1617				
80	144	222	338	532	924	2156			
90	136	204	299	441	681	1176	2587		
100	130	191	271	384	554	844	1386	2986	
110	126	182	254	350	485	693	1021	1687	3881
120	121	173	235	316	422	571	776	1109	1764
130	118	167	224	296	388	511	669	903	1294
140	117	163	218	285	370	479	616	809	1109

NOTES:

(1) If an automatic air charge valve is used, tank size may be reduced by 50%.

(2) Increase tank size by 5% for each 1,000 feet elevation above 3,000 feet elevation.

Table 8.11
PLAIN PRESSURE TANK SIZE SELECTION
MINIMUM RECOMMENDED TOTAL STORAGE TANK SIZE (gallons)
(Based on 3,000 ft. elevation above sea level)
WITHOUT AIR VALVE

Flow = 20 gpm, Minimum Pump Running Time = 1.5 minutes

Pump CUT-OUT Pressure (PSIG)	Pump CUT-IN Pressure (PSIG)								
	20	30	40	50	60	70	80	90	100
30	545								
40	334	863							
50	263	507	1232						
60	227	389	709	1669					
70	205	330	534	941	2156				
80	192	296	450	709	1232	2875			
90	182	272	398	588	908	1568	3450		
100	174	255	362	512	739	1125	1848	3981	
110	168	243	338	466	647	924	1362	2250	5175
120	162	230	314	421	563	761	1035	1479	2352
130	158	222	299	395	518	681	892	1203	1725
140	155	217	291	381	493	639	821	1078	1479

NOTES:

(1) If an automatic air charge valve is used, tank size may be reduced by 50%.

(2) Increase tank size by 5% for each 1,000 feet elevation above 3,000 feet elevation.

Table 8.12
PLAIN PRESSURE TANK SIZE SELECTION
MINIMUM RECOMMENDED TOTAL STORAGE TANK SIZE (gallons)
(Based on 3,000 ft. elevation above sea level)
WITHOUT AIR VALVE

Flow = 25 gpm, Minimum Pump Running Time = 1.5 minutes

Pump CUT-OUT Pressure (PSIG)	Pump CUT-IN Pressure (PSIG) 20	30	40	50	60	70	80	90	100
30	681								
40	417	1078							
50	328	634	1540						
60	284	486	886	2087					
70	257	412	667	1176	2695				
80	240	370	563	886	1540	3594			
90	227	340	498	735	1135	1960	4312		
100	217	319	452	640	924	1406	2310	4976	
110	210	304	423	583	809	1155	1702	2812	6469
120	202	288	392	526	703	951	1294	1848	2940
130	197	278	374	494	647	851	1115	1504	2156
140	194	272	363	476	616	799	1027	1348	1848

NOTES:

(1) If an automatic air charge valve is used, tank size may be reduced by 50%.

(2) Increase tank size by 5% for each 1,000 feet elevation above 3,000 feet elevation.

8.5 PRESSURE SWITCHES

8.5.1 Switch Characteristics

Pressure switches are designed for certain pressure ranges, and electric voltage and amperage services. For most low pressure systems the switch pressure settings are pre-set at the factory. For higher pressure switches, the threshold cut-in and cut-out pressures can usually be adjusted. Any adjustment should be made by an experienced pump installer.

The pressure range which should be used to set cut-in and cut-out pressure depends on the operating pressure of the system. Since air is compressed into a very small volume at high pressures, a greater pressure difference is required to store a given volume of water at high pressures.

Tables 8.3 through 8.12 provide recommended cut-in and cut-out pressures for various pump flow rates and tank capacities. The time that a pump should stay on depends on motor characteristics. Too short a cycling time will heat the motor up and shorten the life of the motor and pump. The increased number of pressure surges caused by rapid cycling also hastens deterioration of pipe, valves and fittings.

Tables 8.3 through 8.12 are based on time between pump cycles of 1-1/2 minutes. This is typically a conservative minimum time as recommended by pump motor manufacturers. The tank volumes can be corrected to other run times by using the following equation:

$$\text{Corrected tank volume} = \frac{\text{Run time (minutes)} \times \text{table volume}}{1.5}$$

8.5.2 Pressure Gauges

An accurate pressure gauge is a very important accessory for a pressure pipeline. With a good pressure gauge, problems such as leaks, pump wear and pressure surges can be spotted.

Frequently, low cost pressure gauges are used. They last a very short time in the damp atmosphere of most pump enclosures. For about $40.00, a good liquid filled gauge with a stainless steel case can be obtained and is highly recommended.

8.6 Eletrical Pump Control Equipment

8.6.1 Automatic Water Level Control

A float switch which directly controls a pump is illustrated in Figure 8.17

In addition to controlling the filling of a single tank, these types of switches can be used to fill a tank from which a gravity pipeline system is fed.

Figure 8.17
FLOAT SWITCH PUMP CONTROL